

WHAT IS CLAIMED IS:

1. An optical pulse timing detection apparatus comprising:

an optical switch for forming an on-state region at only an irradiated portion thereof when irradiated with a control beam pulse, and transmitting or reflecting incident signal beam pulses at the on-state region so as to spatially switch an optical path for the signal beam pulses;

a photo-detector equipped with a plurality of pixels to detect signal beam pulses transmitted or reflected at the on-state region of the optical switch, at a pixel corresponding to the region; and

a timing computation unit for acquiring position information of a pixel, at which a predetermined signal beam pulse has been detected, on the basis of a result of the detection conducted by the photo-detector, and computing timing of arrival of a predetermined signal beam pulse at the optical switch on the basis of the position information of the pixel and a time when a region corresponding to the pixel is brought into an on-state.

2. An optical pulse timing detection apparatus according to claim 1, wherein the optical switch is disposed perpendicularly to a travel direction of the incident signal beam pulses, and the optical switch is disposed so as to be

inclined at a predetermined angle to a travel direction of the control beam pulse.

3. An optical pulse timing detection apparatus according to claim 1, wherein the optical switch is disposed perpendicularly to a travel direction of the control beam pulse, and the optical switch is disposed so as to be inclined at a predetermined angle to a travel direction of the incident signal beam pulses.

4. An optical pulse timing detection apparatus according to claim 1, wherein the optical switch is irradiated with the control beam pulse in synchronization with incidence timing of the signal beam pulses.

5. An optical pulse timing detection apparatus according to claim 1, wherein the photo-detector comprises a spot beam position sensor utilizing surface resistance of a photodiode.

6. An optical pulse timing detection apparatus according to claim 1, wherein the photo-detector comprises a CCD camera.

7. An optical pulse timing detection apparatus according to claim 1, wherein the photo-detector comprises a photo-detector array.

8. An optical pulse timing detection apparatus according to claim 1, wherein an expansion optical system or a compression optical system is disposed between the optical switch and the photo-detector.

9. An optical pulse timing detection apparatus according

to claim 1, wherein the optical switch comprises a functional thin film including a nonlinear optical material whose absorption coefficient is changed by irradiation with a beam, and whose relaxation time is short.

10. An optical pulse timing detection apparatus according to claim 9, wherein the optical switch forms an on-state region by using oversaturated absorption in the nonlinear optical material.

11. An optical pulse timing detection apparatus according to claim 9, wherein the optical switch forms an on-state region by using the optical Kerr effect in the nonlinear optical material.

12. An optical pulse timing detection apparatus according to claim 9, wherein the functional thin film comprises a dye molecular film.

13. An optical pulse timing detection apparatus according to claim 12, wherein the dye molecular film comprises a J-aggregate substance of a squarylium dye.

14. An optical pulse timing detection apparatus according to claim 1, further comprising a signal processing apparatus for conducting signal processing on an output signal of the photo-detector.

15. An optical pulse timing detection apparatus according to claim 14, wherein, due to the signal processing, a spatial position of a beam pulse is detected with a resolution finer

than a spatial resolution of the photo-detector.

16. An optical pulse timing detection method comprising the steps of:

using an optical switch for forming an on-state region at only an irradiated portion thereof when irradiated with a control beam pulse, irradiating the optical switch with a control beam pulse, and transmitting or reflecting incident signal beam pulses at the on-state region so as to spatially switch an optical path for the signal beam pulses;

detecting signal beam pulses transmitted or reflected by the on-state region of the optical switch, at a pixel of a photo-detector equipped with a plurality of pixels, which pixel corresponds to the region;

acquiring position information of a pixel at which a predetermined signal beam pulse has been detected, on the basis of a result of the detection conducted by the photo-detector; and

computing timing of arrival of a predetermined signal beam pulse at the optical switch on the basis of the position information of the pixel and a time when a region corresponding to the pixel is brought into an on-state.

17. An optical pulse timing detection method according to claim 16, wherein signal processing is conducted on an output signal of the photo-detector.

18. An optical pulse timing detection method according

to claim 17, wherein, due to the signal processing, a spatial position of a beam pulse is detected with a resolution finer than a spatial resolution of the photo-detector.

19. An optical pulse timing adjustment apparatus comprising:

an optical switch for forming an on-state region at only an irradiated portion thereof when irradiated with a control beam pulse, and transmitting or reflecting incident signal beam pulses at the on-state region so as to spatially switch an optical path for the signal beam pulses;

a photo-detector equipped with a plurality of pixels to detect signal beam pulses transmitted or reflected at the on-state region of the optical switch, at a pixel corresponding to the region;

a timing computation unit for acquiring position information of a pixel, at which a predetermined signal beam pulse has been detected, on the basis of a result of the detection conducted by the photo-detector, and computing timing of arrival of a predetermined signal beam pulse at the optical switch on the basis of the position information of the pixel and a time when a region corresponding to the pixel is brought into an on-state; and

a delay apparatus for delaying subsequent signal beam pulses on the basis of timing computed by the timing computation unit,

wherein timing of arrival of the signal beam pulses at the optical switch is adjusted.

20. An optical pulse timing adjustment apparatus according to claim 19, wherein signal processing is conducted on an output signal of the photo-detector.

21. An optical pulse timing adjustment apparatus according to claim 20, wherein, due to the signal processing, a spatial position of a beam pulse is detected with a resolution finer than a spatial resolution of the photo-detector.

22. An optical pulse timing adjustment apparatus according to claim 19, wherein the delay apparatus delays subsequent signal beam pulses so as to make timing of arrival of the subsequent signal beam pulses at the optical switch become a predetermined timing.

23. An optical pulse timing adjustment apparatus comprising:

an optical switch for forming an on-state region at only an irradiated portion thereof when irradiated with a control beam pulse, and transmitting or reflecting incident signal beam pulses of a plurality of kinds at the on-state region so as to spatially switch optical paths for the signal beam pulses of the plurality of kinds;

a photo-detector equipped with a plurality of pixels to detect signal beam pulses of the plurality of kinds transmitted or reflected at the on-state region of the optical switch, at

a pixel corresponding to the region;

a timing computation unit for acquiring position information of a pixel, at which a predetermined signal beam pulse has been detected, on the basis of a result of the detection conducted by the photo-detector, and computing timing of arrival of a predetermined signal beam pulse at the optical switch on the basis of the position information of the pixel and a time when a region corresponding to the pixel is brought into an on-state; and

a plurality of delay apparatuses respectively provided for the kinds of signal beam pulses to delay subsequent signal beam pulses so as to make timing of arrival of signal beam pulses of the plurality of kinds at the optical switch become a predetermined timing, on the basis of timing computed by the timing computation unit,

wherein timing of arrival of the signal beam pulses of the plurality of kinds at the optical switch is individually adjusted.

24. An optical pulse timing adjustment apparatus according to claim 19, wherein the delay apparatus changes a length of an optical path to the optical switch for signal beam pulses and thereby delays subsequent signal beam pulses.

25. An optical pulse timing adjustment method comprising the steps of:

using an optical switch for forming an on-state region

at only an irradiated portion thereof when irradiated with a control beam pulse, irradiating the optical switch with a control beam pulse, and transmitting or reflecting incident signal beam pulses at the on-state region so as to spatially switch an optical path for the signal beam pulses;

detecting signal beam pulses transmitted or reflected by the on-state region of the optical switch, at a pixel of a photo-detector equipped with a plurality of pixels, which pixel corresponds to the region;

acquiring position information of a pixel at which a predetermined signal beam pulse has been detected, on the basis of a result of the detection conducted by the photo-detector;

computing timing of arrival of a predetermined signal beam pulse at the optical switch on the basis of the position information of the pixel and a time when a region corresponding to the pixel is brought into an on-state; and

delaying subsequent signal beam pulses on the basis of the computed timing so as to adjust timing of arrival of the signal beam pulses at the optical switch.